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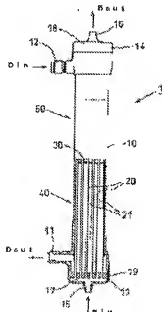
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## (54) HEMODIALYSIS FILTER AND FILTERING DEVICE

## (57)Abstract:

**PROBLEM TO BE SOLVED:** To provide an improved hemodialysis filter which is substantially of the same size as the conventional one, can be applied to the existing dialysis controlling device with a substantial size as such and good operation, also exerts no substantial influence upon the flow of blood, and can perform large-volume filtration (liquid replacement) and a hemodialysis filtering device using it, wherein the medium to high molecular weight substances in blood, which is prone to occur in a chronic dialysis patient and is thought to influence long-term complications, can be easily and effectively removed.

**SOLUTION:** The hemodialysis filter 1 comprising one module having a casing 10, a normal filtering chamber 40, an inverse filtering chamber 50, entrance and exit ports 15 and 16 for blood, and entrance and exit ports 11 and 12 for a dialyzing fluid, wherein the casing 10 has a partition wall 30 and there are the normal filtering chamber 40 and the inverse filtering chamber 50 therethrough. A connecting dialyzing fluid passage having a pressure loss means is included between the normal filtering chamber 40 and the inverse filtering chamber 50. It causes a great pressure difference in the flow of the dialyzing fluid and enables large-volume liquid replacement.



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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to a hemodialysis filter and a hemodialysis filter, and relates to the hemodialysis filter which incorporated especially the hemodialysis filter and this hemodialysis filter of the hollow fiber mold used for body fluid purification therapies, such as hemodialysis filtration, in the therapy of chronic renal failure etc.

[0002]

[Description of the Prior Art] A kidney function falls and, as for a renal failure patient, the removal function of harmful matter in the living body like moisture content accommodation and a urea falls. Therefore, the therapy for blood purification is needed. Hemodialysis excellent in the removal ability of the low-molecular-weight matter which used the diffusion phenomenon by the concentration gradient as the cure, and blood filtration which was excellent in the removal ability of the amount matter of macromolecules while using differential pressure - are performed. In recent years, the hemodialysis filtration having both good point is devised, and some proposals, such as bottle dilution mold blood filtration, Push/Pull hemodialysis filtration, and on-line hemodialysis filtration that uses as a displacing solution the dialysing fluid which let the filter pass, are made.

[0003] Other hemodialysis filter techniques are proposed (see JP, 7-59849, A, JP, 9-84873, A, JP, 11-319079, A, etc.). To the dialysing fluid in a hemodialysis filter, these techniques will produce big differential pressure (pressure loss), by the time it reaches [ from the inlet port ] an outlet, and they will also raise filtration effectiveness with dialysis. More specifically these hemodialysis filters One module, i.e., tubed casing, and the hollow fiber with which it is loaded into this casing. It consists of a close outlet of the blood formed in said casing, and a close outlet of dialysing fluid. In the hemodialysis filter of said JP, 7-59849, A printing He is trying to obtain bigger differential pressure than the conventional thing by making the die length of the longitudinal shaft orientations of said casing into the thing of the shape of about about 10-time long picture as compared with the diameter of this casing. moreover, in the hemodialysis filter of said JP, 9-84873, A printing By making small partially the dialysing fluid passage cross section to which the insertion object which has bloating tendency to dialysing fluid inside said casing is arranged, and the dialysing fluid in this casing flows between hollow fibers Furthermore, he is trying to obtain big differential pressure in the hemodialysis filter of said JP, 11-319079, A printing by making small partially the dialysing fluid passage cross section to which a pressure is applied to from the exterior and the dialysing fluid of said casing flows between hollow fibers.

[0004] As a hemodialysis filter of further others, it consists of two modules connected in the serial direction or the juxtaposition direction, a pump etc. is formed in each inter module, and what controlled the amount of filtration is proposed (for example, refer to the "kidney and dialysis" separate volume 2001, a HDF therapy. 2001. P36-39, American Society of Nephrology vol.12 September 2001, and A1392 grade).

[0005] Moreover, what consisted of the two bodies is proposed as hemodialyzer (JP, 61-276563, A). By using the two bodies which carried out division parallelization of the dialyzer length, and became short, this technique makes good flow nature of the particle concentration in the blood which flows the inside of a hollow filament, and dialysing fluid, and is giving the possibility of two or more kinds of fiber use by body division.

[0006]

[Problem(s) to be Solved by the Invention] By the way, the dialysis control device of dedication is needed in the above mentioned Push/Pull hemodialysis filtration and on-line hemodialysis filtration, and the hemodialysis filter which consists of two above mentioned modules also needs simple peripheral devices, such as a pump, separately. Furthermore, un-arranging [ that the actuation is easy for neither of the things ] has arisen.

[0007] In the case of the hemodialysis filter which consists of one module, special additional means are not needed, or there is convenience also with magnitude applicable to conventional equipment as it is in it. However, as mentioned above, in order to obtain predetermined differential pressure, the casing of a hemodialysis filter itself [ whether it considers as the shape of a large-sized long picture from the magnitude currently conventionally used widely, and ] In measures, such as crushing the dialysing fluid passage cross section to which the dialysing fluid in casing flows between hollow fibers, and making it small partially, are required and being the former There is a possibility of we being anxious about the effect of the operability on a reason which becomes large-sized, and also transforming the passage of a hollow fiber, i.e., blood, as a result in being the latter, and we are anxious about affecting the flow of blood. Moreover, also in any, it is hard to say that matter removal of the inside in the blood said to have influence on complication over a long period of time tends to occur to a chronic dialysis patient, for example - the amount of macromolecules is performed to extent which can be satisfied with sufficient operability.

[0008] The dialyzer of a publication has an advantage, such as making good flow nature of the particle concentration in the blood which flows the inside of a hollow filament as mentioned above, and dialysing fluid, in said JP, 61-276563, A. However, about hemodialysis filtration, internal filtration required for it, and matter removal of the amount of inside - macromolecules, it is unstated in the official report concerned in any way. Pouring beautiful dialysing fluid to juxtaposition respectively as a practical and desirable gestalt in the example 2 is shown, it is clear not to consider internal filtration required for a dialysis filter, and it is hard to say that it is carried out to extent with which can be satisfied of matter removal of the inside in blood - the amount of macromolecules.

[0009] This invention is to offer the improved hemodialysis filter in which a lot of filtration (liquid permutation) is possible, and the hemodialysis filter using it, without being made in view of such a problem, the purpose's being the same size as substantially as the conventional thing, being able to apply with as it is and sufficient operability to the existing dialysis control unit in size substantially, and also affecting the flow of blood substantially By using the

hemodialysis filter and hemodialysis filter by this invention, it becomes possible to remove easily and effectively the inside in the blood supposed that it tends to generate for example, to the chronic dialysis patient, and has influence on complication over a long period of time - the amount matter of macromolecules.

[0010]

[Means for Solving the Problem] That said purpose should be attained, this invention person etc. inquired wholeheartedly and reached this invention. Namely, at least one forward filtration room and at least one reverse filtration room where this invention loaded with 1 casing and a hollow fiber, And in the hemodialysis filter which consists of one module equipped with the close outlet of blood, and the close outlet of dialysing fluid at least, while having a septum between said forward filtration rooms and said reverse filtration rooms The hemodialysis filter characterized by having the connection dialysing fluid passage which has a pressure loss means between said forward filtration rooms and said reverse filtration rooms.

2) Said forward filtration room and said reverse filtration room are a hemodialysis filter given in one characterized by existing in the serial direction through said septum formed in the decussation direction to arrangement of said hollow fiber.

[0011] 3) Said forward filtration room and said reverse filtration room are a hemodialysis filter given in one characterized by existing in the juxtaposition direction through said septum formed in this direction to arrangement of said hollow fiber.

4) Said connection dialysing fluid passage and said pressure loss means are a hemodialysis filter 2 characterized by being prepared in said septum, or given in three.

5) Said connection dialysing fluid passage and said pressure loss means are a hemodialysis filter 2 characterized by being prepared in the exterior of said septum, or given in three.

6) Said module is a hemodialysis filter given in any 1 term of 1 thru/or 5 characterized by having connection blood passage between said forward filtration rooms and said reverse filtration rooms.

[0012] 7) In the hemodialysis filter which consists of one module equipped with at least one forward filtration room which loaded with casing and a hollow fiber, at least one reverse filtration room, the close outlet of blood, and the close outlet of dialysing fluid at least The hemodialysis filter equipped with the connection dialysing fluid passage which has a pressure loss means between said forward filtration rooms and said reverse filtration rooms while having a septum between said forward filtration rooms and said reverse filtration rooms, The hemodialysis filter characterized by equipping this dialysing fluid passage with the flowmeter which measures a flow rate control unit and/or a flow rate at least. It is alike and is involved.

[0013] The hemodialysis filter of this invention is a device to the plasma and the constituent of blood which were separated from blood and blood used for the blood purification of dialysis filtration. Efficiently, what can perform the liquid permeation more than 7L by 4-hour dialysis time amount at least more preferably than more than 5L is desirable.

[0014] A hollow fiber is film which blood flows the lumen side which is the semipermeable membrane which became the shape of yarn which has a lumen (centrum), and is an internal surface, dialysing fluid flows an outside surface, and dialysis, a filtration phenomenon, or both generate through semipermeable membrane. Blood passage is the passage of the blood which flows the hollow fiber

lumen (centrum) with which the dialysis filter was loaded chiefly.

[0015] Dialysing fluid passage is the passage of the dialysing fluid which flows between the hollow fibers with which the dialysis filter was loaded chiefly. A forward filtration room is a field to which it has blood passage and dialysing fluid passage, a forward filtration phenomenon (dewatering) mainly concerns, and it is coming. A reverse filtration room is a field to which it has blood passage and dialysing fluid passage, a reverse filtration phenomenon (water addition) mainly concerns, and it is coming. Connection blood passage is blood passage which connects the blood passage of each of said \*\*, when the hollow fiber loaded with said each \*\* is not one thing connected without the break. Connection dialysing fluid passage is dialysing fluid passage which connects the dialysing fluid passage of each of said \*\*.

[0016] A pressure loss means is a means of the arbitration which can generate pressure loss in connection dialysing fluid passage. A means to generate pressure loss only by resistance with a passage wall surface may be used, and a means to generate pressure loss may be used by changing the passage cross section. Both sides may be employed as coincidence. Moreover, the mode which establishes a passage cross-section change means like an orifice in the middle of connection dialysing fluid passage is sufficient, and the connection dialysing fluid passage itself may be an orifice.

[0017] A septum is a wall which separates a forward filtration room and a reverse filtration room. Casing is a container which has the close outlet of blood, and the close outlet of dialysing fluid. A module is a configuration equipped with at least one forward filtration room which loaded with casing and a hollow fiber, at least one reverse filtration room, the close outlet of blood, and the close outlet of dialysing fluid at least, and the interior is equipped with a septum and connection dialysing fluid passage. Moreover, connection blood passage may be included in the configuration. In addition, not all the volume of each of said \*\* needs to be the same, and the same does not need to be said of the number of the hollow fiber with which said each \*\* is loaded, and the class.

[0018] In this invention, by the differential pressure formed by the pressure loss means which connection dialysing fluid passage has, the dialysing fluid passage in one \*\* touches blood passage under big differential pressure (+) through a hollow fiber, reverse filtration occurs, dialysing fluid passage touches blood passage under big differential pressure (-) through a hollow fiber, and forward filtration generates it also at \*\* of another side. Therefore, it becomes possible efficiently and to ensure forward filtration and reverse filtration of blood, and removal of the inside in blood - the amount matter of macromolecules can also be performed effectively. And the hemodialysis filter of this invention is the same size as substantially as the conventional thing, remains as it is to the existing dialysis control unit, and can be applied to it. Therefore, improvement in the operability of equipment and reduction of therapy cost can be aimed at to coincidence.

[0019] Moreover, in the conventional hemodialysis filter, the pressure loss which dialysing fluid flows between hollow fibers chiefly, and is generated in dialysing fluid passage is based on friction with a hollow fiber front face and a casing front face. Therefore, in the usual condition, a limit is in the differential pressure obtained. It is not by friction with a hollow fiber front face and a casing front face, and he forms a proper pressure loss means in connection dialysing fluid passage, and is trying to generate pressure loss chiefly in the hemodialysis filter by this invention there. Therefore, without affecting a hollow fiber, big differential pressure can be established easily and the amount of filtration can be increased as a result.

[0020] When the inside of casing is divided into two \*\*, it is not easy to connect directly one indoor blood passage and the indoor blood passage of another side by the hollow fiber connected without the break. Therefore, in the desirable mode of the hemodialysis filter concerning this invention, the connection blood passage where a hollow fiber does not exist was formed between one [ said ] \*\* and \*\* of said another side, and this has easy-sized manufacture of a hemodialysis filter.

[0021] The hemodialysis filter concerning this invention is theoretically compared with the hemodialysis filter concerning the Prior art which puts in a constriction object etc. and makes the dialysing fluid passage cross section small. First, since it can consider that the flow in the dialysing fluid passage in the container loaded with the hollow fiber is the flow in a porous body, generally pressure gradient  $dp/dx$  is expressed by Darcy's equation as shown in a formula (1).

[0022]

[Equation 1]  $dp/dx = \mu v / \kappa$  (1)

Here,  $p$  is a pressure [Pa] and  $x$ , distance [m] and  $\mu$  are [  $p$  / an osmotic coefficient [m<sup>2</sup>] and  $v$  of viscosity [PaS] and  $\kappa$  ] rates [m/s]. However, a rate is the value which \*\* (ed) the flow rate with the cross section of the appearance of passage. However, since it is only specifying pressure gradient  $dp/dx$  to the last, in order for this formula to obtain differential pressure (pressure loss)  $\Delta p$ , distance  $l$  is needed as shown in a formula (2).

[0023]

[Equation 2]

$\Delta p = l \mu v / \kappa$  (2)

Here,  $l$  is the length which has arranged the constriction object used in order to actually make the dialysing fluid passage cross section small.

[0024] On the other hand, when obtaining differential pressure (pressure loss) in the connection dialysing fluid passage where it does not fill up with the hollow filament like this invention, generally the pressure loss when extracting passage rapidly in an orifice etc. is proportional to the square of a rate, as shown in a formula (3).

[0025]

[Equation 3]  $\Delta p = \gamma \zeta v^2 / 2g$  (3)

Here,  $\gamma$  is [ a pressure loss coefficient and  $g$  of specific weight [N/m<sup>3</sup>] and  $\zeta$  ] gravity [m/s<sup>2</sup>].

[0026] As shown in a formula (3), when an orifice etc. is used, it becomes unnecessary, and taking distance  $l$  to dialysing fluid passage, and generating differential pressure (pressure loss) cannot affect and fear effect with the flow of the blood of blood passage, it can change differential pressure (pressure loss), and becomes very advantageous.

[0027]

[Embodiment of the Invention] Hereafter, a drawing explains the gestalt of operation of this invention. Drawing 1 and drawing 2 show the hemodialysis filter in the gestalt of operation of the first of this invention, drawing 1 is the fragmentary sectional view, and drawing 2 is a partial enlarged drawing. The module of the gestalt of this operation consists of casing 10, the forward filtration room 40 which loaded with the hollow fiber 20, the reverse filtration room 50 and the blood input 15, the blood tap hole 16, the dialysing fluid input 12, the dialysing fluid tap hole 11, a blood inflow room 17, a blood outflow room 18, and connection dialysing fluid passage 60. As for the hemodialysis filter 1, even this module is constituted more.

[0028] Casing 10 has the dialysing fluid input 12 in the flank while having the

dialysing fluid tap hole 11 for tubed in nothing and its one flank, and the header 13 which equipped the edge of said one flank of casing 10 with the blood input 15 -- liquid -- the header 14 which was connected densely and equipped the edge of said other flanks of casing 10 with the blood tap hole 16 -- liquid -- it connects densely.

[0029] a hollow fiber 20 is arranged to the longitudinal shaft orientations of casing 10 -- having -- as blood passage -- functioning -- \*\*\*\* -- the interior of casing 10 -- an overall length is covered mostly, for example, it is loaded about with 100-30,000. This hollow fiber 20 consists of polyolefine, polysulfone, a polyacrylonitrile, a polyamide, polyimide, polyether nylon, silicone, polytetrafluoroethylene, or a polyester system polymer alloy like a regenerated cellulose, a cellulosic, polymethylmethacrylate, polyethylene, and polypropylene. Especially, as a hollow fiber suitable for the filtration engine performance, polysulfone and a polyacrylonitrile are desirable. Although not limited especially about the effective film surface product of a hollow fiber 20, are preferably taken about [ 0.2-4.0m ] for two about [ 100cm 2-6.0m ] two.

[0030] the condition that, as for the both ends of a hollow fiber 20, edge opening of this hollow fiber 20 is not blockaded in the both ends of casing 10, respectively -- it is -- septum 19 grade -- liquid -- support immobilization is carried out densely. And the blood inflow room 17 is formed between a header 13 and a septum 19, and, similarly the blood outflow room 18 is formed in a header 14 side. In addition, a septum 19 consists of polyurethane, silicone, and potting material like an epoxy resin, and makes a hollow fiber 20 a bundle, liquefied potting material is poured into the both ends of said bundle by the centrifugal pouring-in method, makes it harden it, and it is formed.

[0031] And in the hemodialysis filter 1 of the gestalt of this operation, it has the septum 30 preferably formed perpendicularly substantially to arrangement of a hollow fiber 20 in the abbreviation center section of casing 10, and the forward filtration room 40 which is one \*\*, and the reverse filtration room 50 which is \*\* of another side exist in casing 10 through a septum 30. And in the gestalt of this operation, the forward filtration room 40 and the reverse filtration room 50 are connected in the serial direction.

[0032] In addition, in order for casing 10, the header 13, and the header 14 to consist of various rigid resin, such as polyethylene, polypropylene, a polycarbonate, polymethylmethacrylate, acrylic resin, rigid polyvinyl chloride, styrene-butadiene copolymer resin, and polystyrene, and to secure internal visibility, it is desirable to be transparent or that it is translucent. Moreover, a septum 19 and a septum 30 consist of polyurethane, silicone, and an epoxy resin.

[0033] As shown in a septum 30 at drawing 2, it has the connection dialysing fluid passage 60 between the reverse filtration room 50 and the forward filtration room 40, and a pressure loss means 61 to produce pressure loss is formed in this connection dialysing fluid passage 60. Although the pressure loss means 61 of the gestalt of this operation are one or more stomata like illustration, if the conditions of said pressure loss means are securable, they will not be restricted to this.

[0034] the hemodialysis filter 1 of the gestalt of this operation -- setting -- the blood from the blood input 15 -- the blood inflow room 17 -- minding -- the interior of a hollow fiber 20 (blood passage) -- entering -- the forward filtration room 40 to the reverse filtration room 50 -- a passage -- the blood outflow room 18 -- minding -- the blood tap hole 16 -- resulting -- On the other hand, the dialysing fluid from the dialysing fluid input 12 to the dialysing fluid tap hole 11 through the dialysing fluid passage 21 passes through the



connection dialysing fluid passage 60 of a septum 30 on the way.

[0035] Since it faces passing and big differential pressure is given by the pressure loss means 61, dialysing fluid will touch by big differential pressure (+) through a hollow fiber to the blood in the reverse filtration room 50, and will touch by big differential pressure (-) through a hollow fiber to the blood in the forward filtration room 40. Since the amount of filtration is determined in the magnitude of said differential pressure, both forward filtration and reverse filtration are promoted. In the process, existence of a septum 30 and the connection dialysing fluid passage 60 does not have effect substantial in the style of [ of a hollow fiber 20 ] blood, either.

[0036] Drawing 3 and drawing 4 show the hemodialysis filter in the gestalt of operation of the second of this invention, drawing 3 is the fragmentary sectional view, and drawing 4 is a partial enlarged drawing. Except for the configuration of the septum which carries out a postscript, and connection dialysing fluid passage, other configurations are the same as the gestalt of the first operation, and, below, are explained focusing on this difference.

[0037] Hemodialysis filter 1A of the gestalt of this operation has septum 30A preferably prepared perpendicularly substantially to arrangement of a hollow fiber 20 in the abbreviation center section of casing 10A, and the forward filtration room 40 which is one \*\*, and the reverse filtration room 50 which is \*\* of another side exist in casing 10A through septum 30A. Here, as shown in casing 10A at drawing 4, connection dialysing fluid passage 60A which connects the reverse filtration room 50 and the forward filtration room 40 with the exterior of septum 30A with the connection dialysing fluid passage covering 62 is formed in the perimeter or a part of casing 10A of a circumferential direction, and, similarly pressure loss means 61A which makes this connection dialysing fluid passage 60A produce pressure loss is prepared in the perimeter or a part of circumferential direction. Although pressure loss means 61A of the gestalt of this operation is the thing of a configuration to which the cross section is gradually changed like illustration, if the conditions of said pressure loss means are securable, it will not be restricted to this.

[0038] In hemodialysis filter 1A of the gestalt of this operation, the dialysing fluid from the dialysing fluid input 12 to the dialysing fluid tap hole 11 through the dialysing fluid passage 21 passes connection dialysing fluid passage 60A located in the exterior of this septum 30A on the way. Since big differential pressure is given by pressure loss means 61A on the occasion of passage, like the case of the above-mentioned hemodialysis filter 1, dialysing fluid can touch dialysing fluid by big differential pressure (+) through a hollow filament to the blood in the reverse filtration room 50, and can touch it by big differential pressure (-) through a hollow filament to the blood in the forward filtration room 40. The advance condition of forward filtration and reverse filtration is the same also in the gestalt of said first operation.

[0039] Drawing 5 and drawing 6 show the hemodialysis filter in the gestalt of operation of the third of this invention, drawing 5 is the fragmentary sectional view, and drawing 6 is a partial enlarged drawing. Except for the configuration of the septum which carries out the postscript of this gestalt, and connection dialysing fluid passage, other configurations are the same as the gestalt of said second operation, and, below, are explained focusing on this difference.

[0040] That is, in hemodialysis filter 1B of the gestalt of this operation, it has the septa 30B and 30B of two sheets preferably formed perpendicularly substantially to arrangement of hollow fiber 20B in the abbreviation center section of casing 10A, and the forward filtration room 40 which is one \*\*, and the reverse filtration room 50 which is \*\* of another side exist in casing 10A

through the septa 30B and 30C of two sheets. In addition, septum 30B is formed by an ingredient and technique equivalent to a septum 19. As shown in drawing 5, it is combined with the connection blood passage covering 71, and the periphery edge of the septa 30B and 30C of two sheets forms the connection blood passage 70 between them. Once the blood which has passed hollow fiber 20B in the forward filtration room 40 enters this connection blood passage 70, it flows into hollow fiber 20B in the reverse filtration room 50. The configuration of connection dialysing fluid passage 60A and pressure loss means 61A is the same as the gestalt of the second operation.

[0041] In hemodialysis filter 1B of the gestalt of this operation, the blood from the blood input 15 goes into the interior of hollow fiber 20B (blood passage) through the blood inflow room 17, and flows into the connection blood passage 70 which passed along and described the forward filtration room 40 above. Then, it goes into the interior of hollow fiber 20B (blood passage) again, and passes along the reverse filtration room 50, and the blood tap hole 16 is reached through the blood outflow room 18. The advance condition of forward filtration and reverse filtration is the same also in the gestalt of operation mentioned above. In hemodialysis filter 1B of the gestalt of this operation, the manufacture becomes easy by having formed the connection blood passage 70 between one \*\* 40 and \*\* 50 of another side.

[0042] Drawing 7 and drawing 8 show the hemodialysis filter in the gestalt of operation of the fourth of this invention, drawing 7 is the partial perspective view, and drawing 8 is a sectional view. The module of the gestalt of this operation consists of the forward filtration room 40 which loaded with casing 10C and hollow fiber 20C, the reverse filtration room 50, blood input 15C, blood tap hole 16C and dialysing fluid input 12C, dialysing fluid tap hole 11C, blood inflow room 17C, blood outflow room 18C, connection dialysing fluid passage 60C, and connection blood passage 70C. As for hemodialysis filter 1C, even this module is constituted more. Header 13C to which dialysing fluid input 12C and dialysing fluid tap hole 11C are formed in the side-attachment-wall) section of nothing and its end section in tubed, and casing 10C equipped the end section with blood input 15C and blood tap hole 16C -- liquid -- it connects densely. the other end of casing 10C -- cylinder-like-object-with-base-like header 14C -- liquid -- it is closed down densely. And in casing 10C, through septum 30C formed in the longitudinal shaft and this direction in the abbreviation center section, the forward filtration room 40 and the reverse filtration room 50 exist, and the forward filtration room 40 and the reverse filtration room 50 are located in the state of juxtaposition. In addition, septum 30C may be manufactured by casing and one, and may be separately combined with one after manufacture.

[0043] Like illustration, hollow fiber 20C covers the overall length of said forward filtration room 40 of casing 10C, and the reverse filtration room 50, and is arranged in accordance with the longitudinal shaft orientations. the both ends of each hollow fiber 20C -- the both ends of casing 10C -- setting -- septum 19C 19C [ 1 and ]2 -- liquid -- support immobilization is carried out densely. Moreover, between header 13C and septum 19C1, it is divided by the extension of said septum 30C, and blood inflow room 17C and blood outflow room 18C are formed. Said blood input 15C connects with blood inflow room 17C, and said blood tap hole 16C connects with blood outflow room 18C. Furthermore, connection blood passage 70C is formed between header 14C and septum 19C2.

[0044] As shown in drawing 7 and drawing 8, it has connection dialysing fluid passage 60C between the reverse filtration room 50 and the forward filtration room 40 in said header 14C side, and pressure loss means 61C which produces pressure loss is prepared in this connection dialysing fluid passage 60C at

septum 30C. Although pressure loss means 61C of the gestalt of this operation is the hole of a minor diameter like illustration, if the conditions of said pressure loss means are securable, it will not be restricted to this. Moreover, it may be formed of a porous body like polyurethane, and the porous body functions as a pressure loss means 61 in that case.

[0045] In hemodialysis filter 1C of the gestalt of this operation The blood from blood input 15C goes into the interior of a hollow fiber 20 (blood passage) through blood inflow room 17C, the forward filtration room 40 -- a passage -- connection blood passage 70C -- having reached -- after -- again -- the interior of hollow fiber 20C (blood passage) -- entering -- the reverse filtration room 50 -- a passage -- a blood outflow room -- it results in blood tap hole 16C through 18C.

[0046] When the dialysing fluid which results in dialysing fluid tap hole 11C through dialysing fluid input 12C to dialysing fluid passage 21C passes connection dialysing fluid passage 60C of septum 30C, big differential pressure is given by pressure loss means 61C. Thereby, like the case of each above-mentioned hemodialysis filter, dialysing fluid can touch by big differential pressure (+) through a hollow filament to the blood in the reverse filtration room 50, and can touch by big differential pressure (-) through a hollow filament to the blood in the forward filtration room 40.

[0047] Drawing 9 and drawing 10 show the hemodialysis filter in the gestalt of operation of the fifth of this invention, drawing 9 is the partial perspective view, and drawing 10 is a fragmentary sectional view. Except for the configuration of the septum which carries out a postscript, and connection dialysing fluid passage, other configurations are the same as the gestalt of said fourth operation, and, below, are explained focusing on this difference.

[0048] In hemodialysis filter 1D of the gestalt of this operation, like above-mentioned hemodialysis filter 1C, septum 30D is prepared in the abbreviation center section of casing 10D in the concurrency direction to arrangement of hollow fiber 20C, and the forward filtration room 40 which is one \*\*, and the reverse filtration room 50 which is \*\* of another side exist in casing 10D through this septum 30D. As shown in drawing 9 and drawing 10, connection dialysing fluid passage 60D between the reverse filtration room 50 and the forward filtration room 40 is formed in the exterior of septum 30D in the header 14C side, and pressure loss means 61D which produces pressure loss is prepared in this connection dialysing fluid passage 60D at casing 10D. Although pressure loss means 61D of the gestalt of this operation is passage like illustration, if the conditions of said pressure loss means are securable, it will not be restricted to this. The advance condition of forward filtration and reverse filtration in the same as the thing of the gestalt of the fourth operation substantially mentioned above, and explanation is omitted.

[0049] As described above, mainly although the pressure loss generated in the dialysing fluid passage of a Prior art was based on friction with dialysing fluid, and the hollow fiber around it and a casing front face, it becomes what has the much more big differential pressure of the dialysing fluid which was made to produce high differential pressure (pressure loss) in the connection dialysing fluid passage 60 between a forward filtration room and a reverse filtration room, and minded the hollow fiber 20, and blood with the hemodialysis filter by this invention. Since the differential pressure serves as a driving force and the amount of filtration is decided, the amount of filtration can be increased as a result. Therefore, without having substantial effect by deformation etc. to a hollow fiber 20, the amount of filtration in the forward filtration room 40 and the reverse filtration room 50 increases, a lot of liquid permutation is

attained, and the amount matter of inside - macromolecules can be removed effectively. And the hemodialysis filter by this invention of a conventional thing and size may be the same, and since it can be applied to the existing dialysis control unit as it is, without using equipments of dedication, such as a pump, it can perform operation with which were satisfied of the both sides of cheap-izing of therapy cost, and improvement in operability.

[0050] In addition, although the pressure loss means was formed in connection dialysing fluid passage in this application in order to perform a lot of filtration, it is possible similarly to apply pressure loss also to the flow of blood and to enlarge dialysing fluid, blood, and differential pressure of a between further by adjusting the cross section in the range which does not affect blood in the connection blood passage 70 (70C).

[0051] Drawing 11 is drawing showing the pressure distribution of said fourth [ the ], the blood in hemodialysis filter 1C (1D) of the gestalt of the fifth operation, and dialysing fluid. In hemodialysis filter 1C (1D) of the gestalt of this operation, it turns out that the big differential pressure between dialysing fluid passage 21C arranged at the forward filtration room 40 and dialysing fluid passage 21C arranged at the reverse filtration room 50 like illustration has arisen by pressure loss means 61C (61D) of connection dialysing fluid passage 60C between a forward filtration room and a reverse filtration room (60B). The same of this point is said of the hemodialysis filter 1 (1A, 1B) of the gestalt of the above-mentioned first thru/or the third operation. In addition, this pressure loss can be produced in the range of 1 - 200mmHg in blood flow rate 200 ml/min and dialysing fluid flow rate 500 ml/min.

[0052] On the other hand, in hemodialysis filter 1C (1D) of the gestalt of this operation, as compared with the hemodialysis filter 1 (1A, 1B) of the gestalt of the above-mentioned first thru/or the third operation, compared with the die length of a container (casing), blood passage and long dialysing fluid passage can be taken further, and the limited tooth space can be used effectively. Thereby, differential pressure of the pressure  $P_{Bin}$  of blood input besides the differential pressure of the pressure  $P_{Din}$  of dialysing fluid input and the pressure  $P_{Dout}$  of a dialysing fluid tap hole and the pressure  $P_{Bout}$  of a blood tap hole can also be enlarged further. As mentioned above, although explained in full detail about the gestalt of some operations of this invention, this invention is not limited to the gestalt of said operation, is the range which does not deviate from the pneuma of invention indicated by the claim, and can perform various modification in a design.

[0053] For example, the thing for which it has two or more \*\* in the case of the hemodialysis filters 1C and 1D which are not limited to it and have a septum in longitudinal shaft orientations although casing of the gestalt of said the operation of each has one forward filtration room and one reverse filtration room -- the passage of blood, and the passage of dialysing fluid -- parenchyma -- it can also consider as structure which is lengthened. Moreover, connection dialysing fluid passage is not limited to the configuration prepared in casing, is the exterior of a septum, for example, may connect the extension part from a forward filtration room and a reverse filtration room by a tube etc. Moreover, the flowmeter and/or the flow rate control unit may be formed additionally, and, thereby, it also becomes possible about the amount of filtration measurement and to adjust appropriately in connection dialysing fluid passage. For example, if the inflow  $Q_{in}$  of dialysing fluid, a flow  $Q_{out}$ , and the measurement flow rate in connection dialysing fluid passage are set to  $Q_x$ , the amount of filtration of a forward filtration room serves as  $Q_{in}-Q_x$ , and the amount of filtration of a reverse filtration room serves as  $Q_x-Q_{out}$ , and can be calculated easily.

[0054] Drawing 12 is the circuitry Fig. of the hemodialysis filter containing the hemodialysis filter of the gestalt of this operation. The hemodialysis filter 80 A flowmeter 81 is formed in connection dialysing fluid passage 600 of hemodialysis filter 10 like illustration. The amount of filtration which measures the flow rate  $Q_x$  of this dialysing fluid directly, and is generated from the difference of this and the inflow  $Q_{in}$  of dialysing fluid at the forward filtration room 40 is measurable, and the amount of reverse filtration in the reverse filtration room 50 is also measurable from a difference with the flow  $Q_{out}$  of dialysing fluid. And a flow rate is controllable by forming the flow rate control unit 82 in accordance with this connection dialysing fluid passage 600. In addition, it is thought that the flow rate control unit 82 has two, or [ whether a flow rate is directly controlled with a pump or / controlling a flow rate by pressure loss (for example, valve) ], in this case. Moreover, the combination of a flowmeter and a flow rate control unit can consider three cases of the ( drawing 12 (c) reference) as a flow control besides considering as pressure loss control with (the drawing 12 (a) reference) and a flowmeter only as a flowmeter which acts as a monitor (referring to drawing 12 (b)). Furthermore, the hemodialysis filter of this invention can also be used again as a purge to the plasma and the constituent of blood which were separated from blood and blood.

[0055]

[Effect of the invention] It is the same size as substantially as the conventional thing, the hemodialysis filter and hemodialysis filter of this invention are applicable to the existing dialysis control unit with as it is and sufficient operability in real size, and a lot of filtration (liquid permutation) of them is attained, without also affecting the flow of blood substantially. By using the hemodialysis filter and hemodialysis filter by this invention, it becomes possible to remove easily and effectively the inside in the blood supposed that it tends to generate for example, to the chronic dialysis patient, and has influence on complication over a long period of time - the amount matter of macromolecules.

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[Translation done.]